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Therefore, $dx=\dfrac{\surd[C^2-2Cy]}{y}dy\ldots.[2]$.

or, $x=2\surd[C^2-2Cy]+C\log\left[\dfrac{\surd[C^2-2Cy]-C}{\surd[C^2-2Cy]+C}\right]+C'\ldots.[3]$.

For $x=a$ and $y=b$, as per the problem, [3] gives the required equation

$$x-a=2\{\surd[C^2-2Cy]-\surd[C^2-2bC]\}$$

$$+C\log\left[\frac{\surd[C^2-2Cy]-C}{\surd[C^2-2Cy]+C}\Big/\frac{\surd[C^2-2bC]-C}{\surd[C^2-2bC]+C}\right]\ldots.[4].$$

Also solved by *L. C. WALKER* and *H. C. WHITAKER*. Professor Matz gave a second solution using polar co-ordinates.

135. Proposed by COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tenn.

To find the equation of the evolute of the common catenary

$$y=(\tfrac{1}{2}c)(e^{x/c}+e^{-x/c}).$$

Solution by G. B. M. ZERR, A. M., Ph. D., The Temple College, Philadelphia, Pa., and M. E. GRABER, Heidelberg University, Tiffin, O.

$$\frac{dy}{dx}=\tfrac{1}{2}(e^{x/c}-e^{-x/c}),\quad \frac{d^2y}{dx^2}=\frac{1}{2c}(e^{x/c}+e^{-x/c}).$$

$\therefore$ $x-m+(y-n)dy/dx=0$, $1+(dy/dx)^2+(y-n)d^2y/dx^2=0$ become

$$x-m+\tfrac{1}{4}c(e^{2x/c}-e^{-2x/c})-\tfrac{1}{2}n(e^{x/c}-e^{-x/c})=0\ldots.(1).$$

$$1+\tfrac{1}{4}(e^{x/c}-e^{-x/c})^2+\tfrac{1}{4}(e^{x/c}+e^{-x/c})^2-\frac{n}{2c}(e^{x/c}+e^{-x/c})=0\ldots.(2).$$

From (2), $e^{4x/c}-\dfrac{n}{c}e^{3x/c}+2e^{2x/c}-\dfrac{n}{c}e^{x/c}+1=0$.

Let $e^{x/c}=z$.

$\therefore$ $z^4-\dfrac{n}{c}z^3+2z^2-\dfrac{n}{c}z+1=0$, $(z^2+1)(z^2-\dfrac{n}{c}z+1)=0$.

$\therefore$ $z=\dfrac{n\pm\surd(n^2-4c^2)}{2c}=e^{x/c}$ and $\dfrac{n\mp\surd(n^2-4c^2)}{2c}=e^{-x/c}$.

$\therefore$ $x=c\log\left(\dfrac{n\pm\surd(n^2-4c^2)}{2c}\right)$.

These values in (1) give us

$$c\log\left(\frac{n\pm\sqrt{(n^2-4c^2)}}{2c}\right)-m\mp\frac{n}{4c}\sqrt{(n^2-4c^2)}=0,$$

for the equation to the evolute.

**136. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics in The Temple College, Philadelphia, Pa.**

Evaluate the definite integral

$$\int_0^1\int_0^1\frac{v^{l-1}u^{m-1}(1-v^n)^{p-1}(1-u^s)^{r-1}dvdu}{[bv^n+c(1-v^n)]^{p+l/n}(u^s+a)^{r+m/s}}.$$

**Solution by the PROPOSER.**

Let $u^n=z$, $u^s=w$, $A$=value of integral.

$$\therefore A=\int_0^1\int_0^1\frac{z^{l/n-1}w^{m/s-1}(1-z)^{p-1}(1-w)^{r-1}dzdw}{[bz+c(1-z)]^{p+l/n}(w+a)^{r+m/s}}.$$

$$\text{Let } z=\frac{cy}{b(1-y)+cy},\quad \frac{w}{w+a}=\frac{x}{1+a}.$$

$$\therefore A=\frac{1}{a^r(1+a)^{m/s}b^{l/n}c^p}\int_0^1\int_0^1 y^{l/n-1}x^{m/s-1}(1-y)^{p-1}(1-x)^{r-1}dydx$$

$$=\frac{1}{a^r(1+a)^{m/s}b^{l/n}c^p}\cdot\frac{\Gamma(l/n)\Gamma(p)\Gamma(m/s)\Gamma(r)}{\Gamma(l/n+p)\Gamma(m/s+r)}.$$

## MECHANICS.

**133. Proposed by J. C. CORBIN, Superintendent of Schools, Pine Bluff, Ark.**

A stick of square-edged timber is 20 feet long, 10 inches square at large end, and 6 inches square at small end. How far from either end must a hand spike be placed so that two men with the hand spike and one man at the end shall each have an equal weight to carry?

**Solution by G. B. M. ZERR, A. M., Ph. D., The Temple College, Philadelphia, Pa., and P. H. PHILBRICK, C. E., Lake Charles, La.**

Let $H$=height of pyramid, base 10 inches square; $h$=height of pyramid, base 6 inches square; $z$, $z_1$, $z_2$ the distances of the centers of mass of the frustum, large pyramid and small pyramid, respectively, from the larger base; $m$, $n$ the masses of the two pyramids.

$\therefore mz_1=nz_2+(m-n)z$, $z_1=\frac{1}{4}H$, $z_2=\frac{1}{4}h+H-h=H-\frac{3}{4}h$.

Also the masses are to each other as the cubes of the heights.

$\therefore \frac{1}{4}H^4=h^3(H-\frac{3}{4}h)+z(H^3-h^3)$.